On Aligning OpenIE Extractions with Knowledge Bases: A Case Study

Kiril Gashteovski[1,2] Rainer Gemulla[1]
Bhushan Kotnis[2] Sven Hertling[1] Christian Meilicke[1]

[1]University of Mannheim [2]NEC Labs Europe
Germany

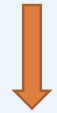
UNIVERSITY OF MANNHEIM

NEC

Open Information Extraction (OpenIE)

Extract **triples** from natural language text in unsupervised manner

"Michael Jordan, who played for the Chicago Bulls, was born in Brooklyn."



("Michael Jordan"; "was born in"; "Brooklyn")
("Michael Jordan"; "played for "; "Chicago Bulls")

OpenIE

Ambiguous: triples whose elements are strings

(*"Michael Jordan"*; *"played for "*; *"Chicago Bulls"*)

"Michael Jordan" → 16 entities in Wikipedia

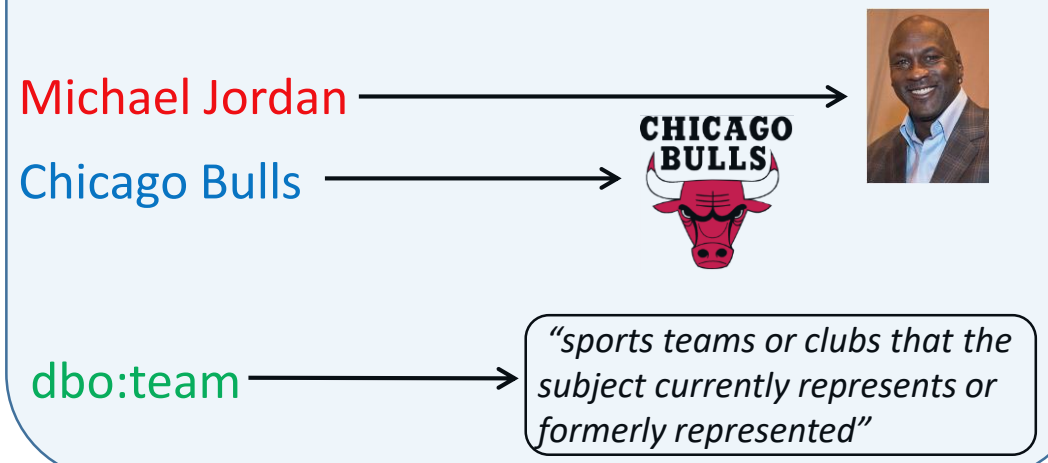
"Chicago Bulls" → 2 entities in Wikipedia

"played for" → string, does not have precise meaning

Knowledge Bases (KBs)

Unambiguous: triples whose elements are unambiguous concepts

(Michael Jordan; dbo:team; *Chicago Bulls*)



KBs suffer from low coverage

OpenIE and KBs

- OpenIE can be used to construct or enhance KBs

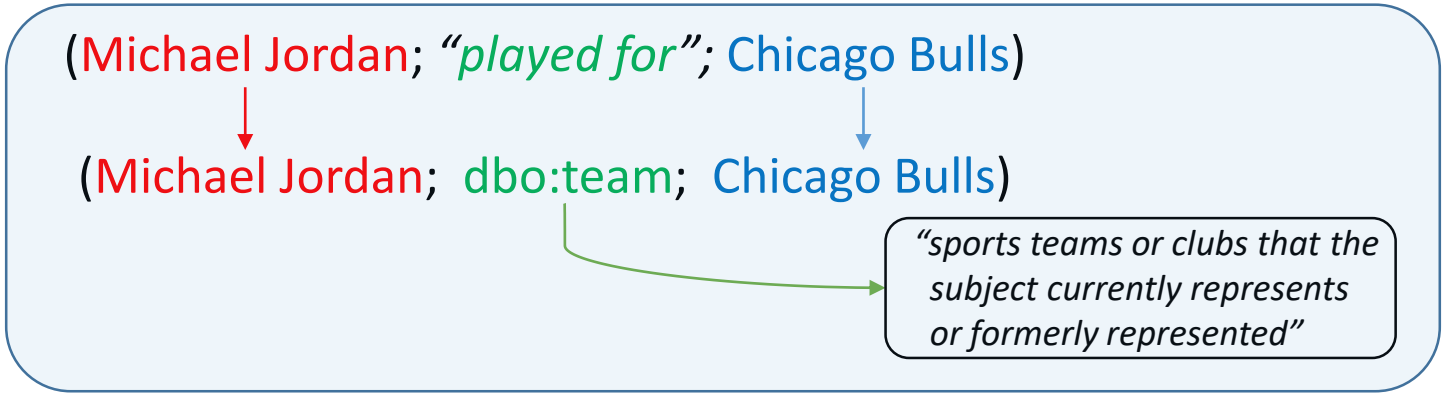
Question:

How the information in OpenIE triples relates to the information in a KB?

- We **manually evaluate** the semantic relatedness between OpenIE and KB
  - We used the OpenIE corpus **OPIEC** and **DBpedia** KB

OpenIE triples and KB facts with same arguments

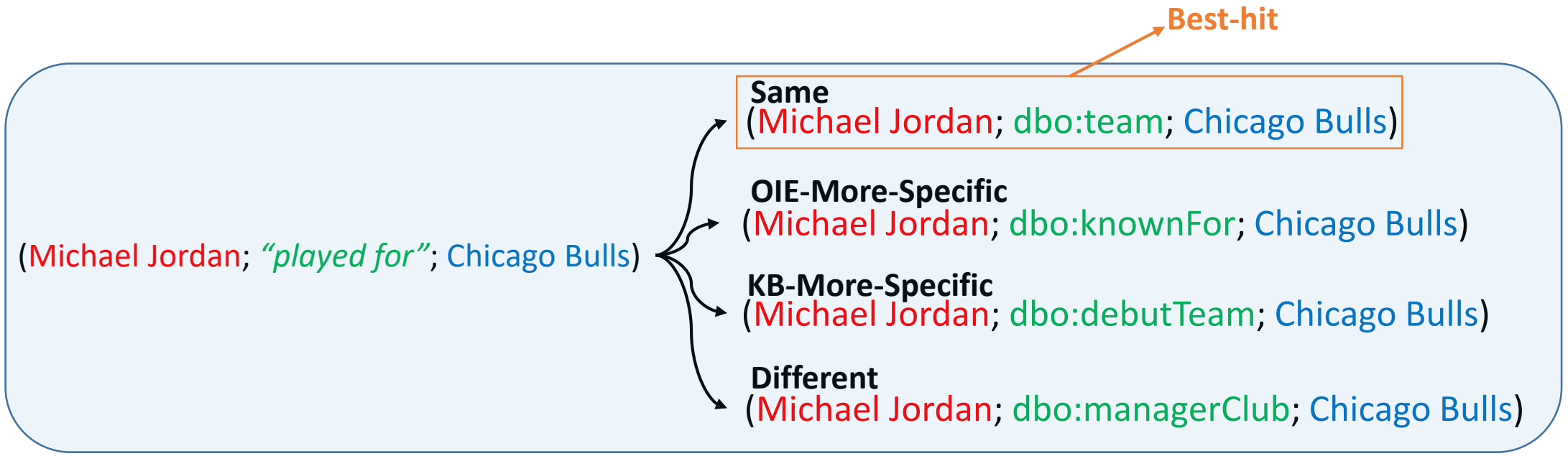
- Inspired by the **Distant Supervision Assumption (DSA)**
  - **KB-Hit:** for an OpenIE triple there is a KB fact with same argument pair
  - **DSA:** They express the same information



- Key assumption: used for bootstrapping OpenIE and expanding KBs

OpenIE triples and KB facts with same arguments

- KB-hit may not always have equivalent semantics as the OpenIE triple
  - for each KB-hit, we differentiate four **hit categories**

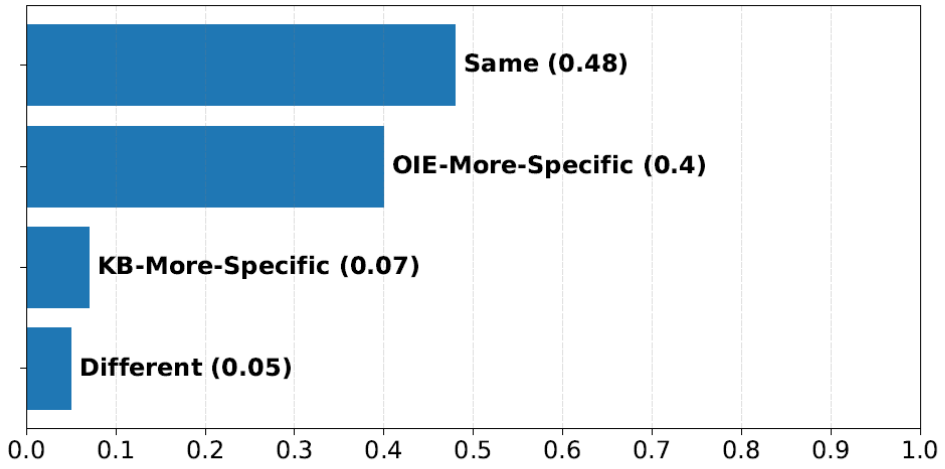


OpenIE triples and KB facts with same arguments

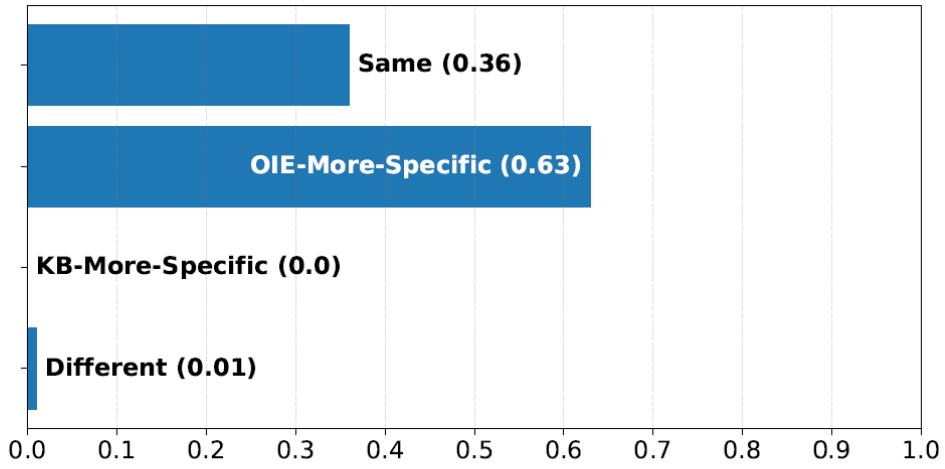
- Split the OpenIE triples in two groups:
  - *Is-a relation*: indicate **types**; e.g. *(“Michael Jordan”; “be”; “basketball player”)*
  - *All relations:* all other OpenIE triples
- Manually assign **best hit category** on each OpenIE triple

OpenIE triples and KB facts with same arguments

- Most OpenIE triples express the best hit
  - Though, the OpenIE triples tend to be more specific
- OpenIE triples contain more fine-grained type information



(a) *All relations*



(b) *Is-a relation*

Expressibility of an OpenIE triple with a DBpedia fact

- To what extent an OpenIE triple contains information **relevant** for DBpedia?
- Three possible **expressibility levels**

(Michael Jordan; *"played in"*; NBA) —*Fully-Expressible*→ (Michael Jordan; dbo:league; NBA)

(Michael Jordan; *"played for Bulls in"*; NBA) —*Partly-Expressible*→ (Michael Jordan; dbo:league; NBA)

(Michael Jordan; *"be fielding a NASCAR team with"*; Bubba Wallace) —*Not-Expressible*→ **X**

Expressibility of an OpenIE triple with KB formulas

(Michael Jordan; *"played for Bulls in"*; NBA)

↓ *Fully-Expressible*

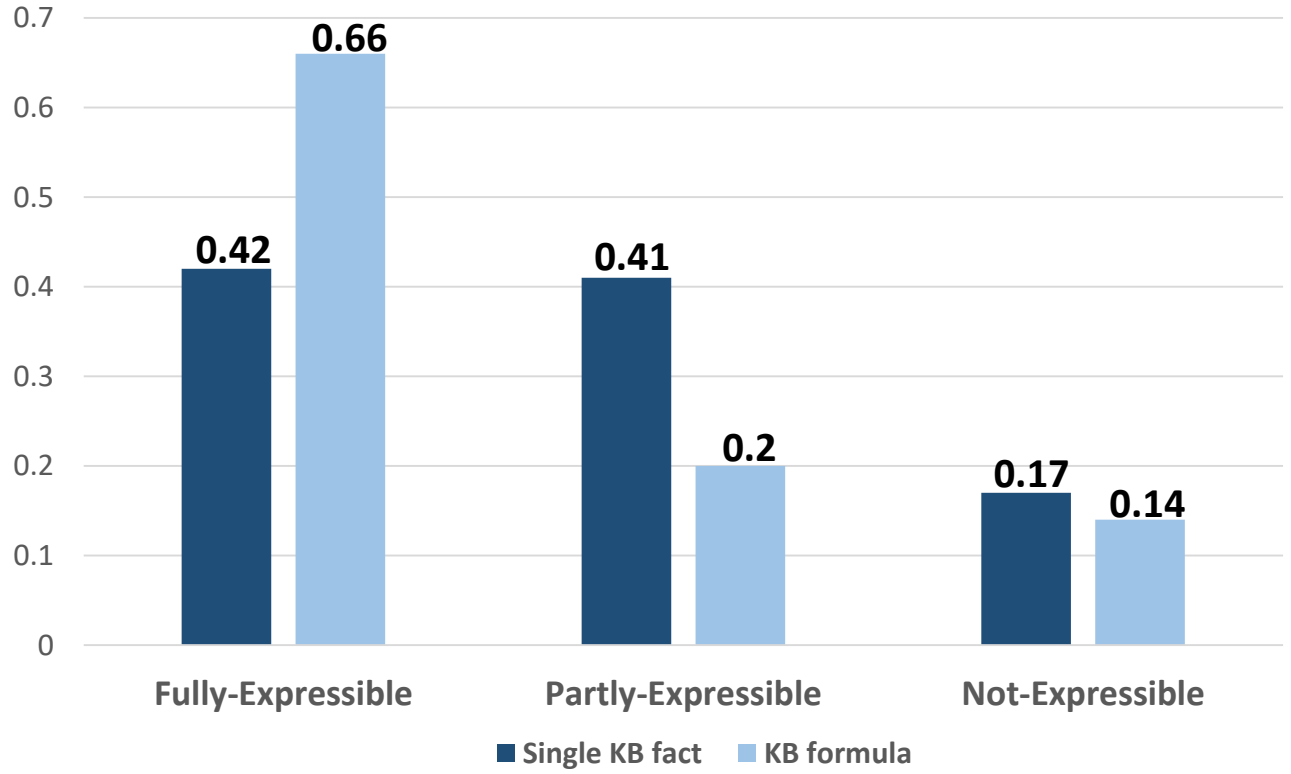
(Michael Jordan; dbo:league; NBA) $\wedge$ (Michael Jordan; dbo:team; Chicago Bulls)

Expressibility of an OpenIE triple with DBpedia

- Expert annotator labeled a sample of OpenIE triples
  - **Candidate generation** strategies: single KB fact and KB formula

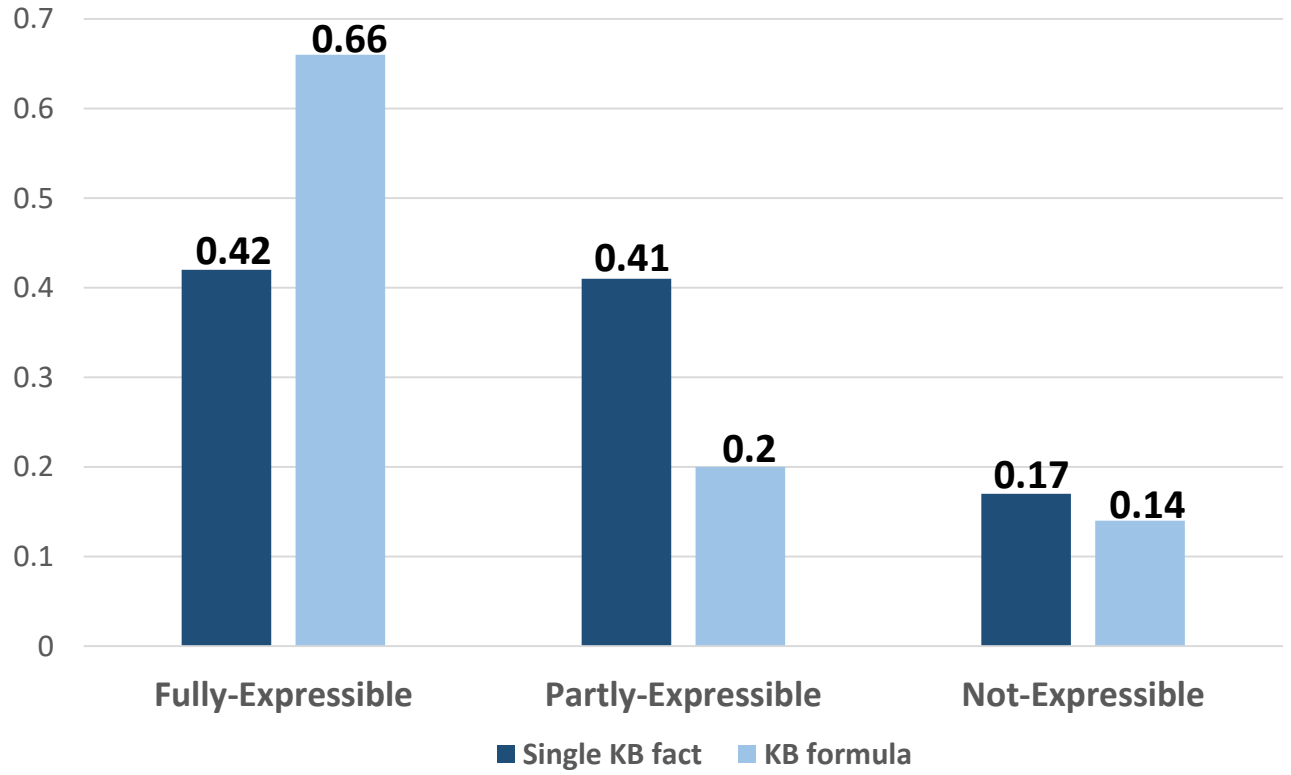
Expressibility of an OpenIE triple with DBpedia

- Most OpenIE triples can be expressed with **single DBpedia fact**
- **KB formulas** significantly increase the expressibility of OpenIE triples



Expressibility of an OpenIE triple with DBpedia

- Most OpenIE information relevant for DBpedia is **not present in DBpedia**



Takeaways

- **Distant Supervision Assumption (DSA)** for OpenIE
  - Mostly satisfied
  - OpenIE triples tend to be more specific

- **Expressibility** of OpenIE triples with DBpedia
  - Most OpenIE triples are **relevant for DBpedia**
  - **KB formulas** significantly increase expressibility
  - Most OpenIE information that is relevant for DBpedia is not present in DBpedia

- **Transferability:** our findings largely transfer over to other OpenIE systems

https://www.uni-mannheim.de/dws/research/resources/opiec/